CLAIMS

1. A method of providing assistance in navigating an aircraft (99), the method being characterized by calculating a three-dimensional continuous predicted trajectory (TDC) on board the aircraft as a function of itinerary data (ITI) and characteristics of the aircraft.

2. A method according to claim 1, in which, for the majority of the points of the predicted trajectory of the aircraft, a predicted time/date and/or speed is/are calculated as a function in particular of the characteristics of the aircraft.

3. A method according to claim 1 or claim 2, in which simulation is used to calculate at least a portion of the predicted trajectory in discrete manner, from an initial state vector (VEI) of the aircraft, preferably using for this purpose an autopilot simulation (SPA) module, an aircraft simulation (ATS) module, and a guidance simulation (SGU) module.

4. A method according to any one of claims 1 to 3, in which at least a portion of the predicted trajectory is calculated analytically, by solving a system of differential equations.

5. A method according to any one of claims 1 to 4, in which a curvilinear portion of the trajectory is calculated on the basis of a rate of variation in heading or in altitude that is less than the rate corresponding to the autopilot limitations.

6. A method according to any one of claims 1 to 5, in which the predicted trajectory does not have any angle point.

7. A method according to any one of claims 1 to 6, in which input of data modifying the itinerary and/or the trajectory is monitored, and in the event of an operator inputting data to modify the itinerary and/or the trajectory, the calculation of the trajectory is reiterated.

8. A method according to any one of claims 1 to 7, in which all or part of a state vector of the aircraft is monitored and/or measured, in particular a 3D position component, a 3D speed component, aircraft weight, and/or a state for each engine, and in the event of a substantial change in the state vector being detected, the trajectory calculation is reiterated.

9. A method according to any one of claims 1 to 8, in which an aircraft environment parameter is monitored and/or measured, in particular wind speed, and/or air density or temperature, and whenever a substantial change in an environment parameter is detected, calculation of the trajectory is reiterated.

10. A method according to any one of claims 1 to 9, comprising the following steps:

i) recording in at least one on-board memory predicted capabilities or characteristics for the aircraft, together with a terrain and obstacle model; and then with the help of an on-board computer:

ii) calculating said predicted trajectory to be close to the itinerary and to correspond to said predicted capabilities or characteristics of the aircraft;

iii) determining a tube or tunnel extending along the trajectory and of section that corresponds to safety margins;

iv) looking to see whether a point of the terrain and obstacle model is included inside the tube or tunnel,

and if so determining at least one trajectory portion that interferes with the terrain and obstacle model; and then

v) presenting to an on-board operator said trajectory and/or said trajectory portion that interferes, and doing so at a presentation frequency.

11. A method according to any one of claims 1 to 10, in which any interference between a safety volume extending along the setpoint trajectory and a terrain and obstacle model is determined, and any interference is presented to an on-board operator in a manner that is repeated in time and at a presentation frequency that is high enough to enable the itinerary to be modified so as to cause the interference to disappear.

12. A method according to claim 10 or claim 11, in which said presentation frequency is not less than 1 Hz.

13. A method according to claim 12, in which said frequency lies in the range 5 Hz to 100 Hz.

14. A method according to any one of claims 10 to 13, in which, in order to present any said interference to the pilot or operator, the following are displayed on a screen: a chart and/or a profile of the terrain to be overflown; a horizontal and/or vertical projection of the itinerary together with a horizontal and/or vertical section of the trajectory; and a first distinctive sign given to the portion(s) of the trajectory for which interference has been determined.

15. A method according to any one of claims 1 to 14, in which said trajectory is corrected at regular time intervals at an updating frequency as a function of current parameters relating to the aircraft, the current point of the aircraft flight, and current parameters

relating to the outside environment so as to obtain an updated setpoint trajectory for the pilot and/or the autopilot.

16. A method according to any one of claims 1 to 15, in which it is verified that the distance between the predicted trajectory and the current position of the aircraft remains below a predetermined value, and if not, an audible alarm is triggered and/or a warning sign is displayed.

17. A method according to claim 16, in which the setpoint predicted trajectory includes a re-joining trajectory (TRV, TRH) calculated to connect the current position of the aircraft to the itinerary.

18. A method according to any one of claims 1 to 17, in which the setpoint trajectory includes at least one takeoff trajectory (H1-ToC) and at least one landing trajectory (FAF-H2).

19. Apparatus (1) on board or mountable on board an aircraft (99) to facilitate navigating, guiding, and piloting the aircraft, the apparatus comprising a system (2) programmed to calculate a three-dimensional continuous predicted aircraft trajectory (TDC) that is close to an itinerary, as a function in particular of aircraft characteristics and itinerary data (ITI).

20. Apparatus according to claim 19 including a tool (7) for inputting itinerary data, a module for monitoring data input by said tool, and for causing the trajectory calculation to be reiterated when itinerary data is modified, and a member (6) for displaying the calculated trajectory.

21. Apparatus according to claim 19 or claim 20, comprising:

- means (3) for acquiring parameters relating to the aircraft and to the outside environment, including means for accurately determining the position of the aircraft in three dimensions;
- a modifiable memory (4) or database for storing the itinerary;
- a memory (5) or database containing data concerning the height of terrain and obstacles to be overflown;
- display means (6) for displaying a chart to an on-board operator;
- an interactive graphics tool (7) for constructing the itinerary;
- trajectory calculation means (2) for calculating an essentially curvilinear trajectory in three dimensions that is close to the itinerary and that corresponds to the predicted capabilities of the aircraft, and preferably doing so at a calculation frequency that is not less than the presentation frequency;
- detector means (2') for detecting any interference between a safety volume extending along said trajectory and terrain overflown by the aircraft;
- a guidance calculator (8) having inputs connected to the trajectory calculation means (2) and to the sensors (3), and having outputs connected both to a pilot data display device (9) and to an autopilot system (9'); and
- visual presentation means (6, 9) for presenting any interference to an on-board operator in a manner that is repeated in time at a presentation frequency that is high enough to enable the operator to modify the itinerary using the interactive tool so as to cause the interference to disappear.

22. Apparatus programmed to implement a method according to any one of claims 1 to 18.